CLARK FORK FISH HATCHERY

ANNUAL REPORT

January 1, 1991 - December 31, 1991

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INTRODUCTION

The Clark Fork Hatchery is a resident species "specialty" station located on Spring Creek, 1.5 miles northwest of Clark Fork, Idaho. Approximately 25,000 westslope cutthroat broodstock are held on-station providing the state's only captive source of westslope cutthroat eggs. In addition to westslope cutthroat, brook, brown, golden, Kamloops, and rainbow trout as well as grayling are reared for distribution in the waters of Region 1. Over 125,000 rainbow trout >9 inches are received each year from production hatcheries in southern Idaho and redistributed from March through October. Originally constructed by the WPA in 1934 and completed in 1938, the Clark Fork Hatchery is now funded for operation by Idaho Department of Fish and Game license fees. Water diverted from Spring Creek provides for incubation and rearing, with flows of 8-15 cfs at temperatures averaging 41°F in winter and 48°F in summer. A well provides approximately 100 gpm of 45°F water to one bank of incubators. Unused well water can be diverted to fiberglass rearing troughs to mix with Spring Creek water. Rearing units include Heath incubator stacks, concrete and fiberglass early rearing vats, concrete raceways, and earthen broodstock ponds.

FISH PRODUCTION

Trout production at the Clark Fork Hatchery addresses three different objectives; (1) maintenance of a captive westslope cutthroat brood stock of 25,000 adults to spawn at age 4 and 5 years, (2) production of 300,000 6-inch or greater westslope cutthroat for large lake stocking, and (3) rearing westslope cutthroat and various other salmonid species to less than 3 inches for release in mountain and lowland lakes (Table 1). Eggs are collected on-station (Table 2), as well as received from public and private sources.

During 1991, the total number of brood fish was reduced to 23,000 from 27,000 fish in 1990 (Table 1). The broodstock management plan was altered in an attempt to improve genetic purity. Rather than selecting replacement broodstock from Brood Year 89 Clark Fork strain westslope cutthroat, a group of genetically pure Brood Year 89 westslope cutthroat obtained from the Montana State Washo Park Hatchery broodstock. These fish were reared at both the Cabinet Gorge and Sandpoint hatcheries prior to arrival at the Clark Fork Hatchery. An increase in average length of the broodstock population was observed in 1991, with adults averaging 11.9 inches (range 9.5-14.4 inches), up from a 1990 average length of 10.3 inches (range 8.6-11.6 inches).

During 1991, 268,411 (21,315 lb) Brood Year 89 6-inch plus westslope cutthroat were released. Another 62,085 (2,042 lb) 5-inch Brood Year 90 westslope cutthroat were transferred to net pens on Lake Pend Oreille for rearing to release in 1992. In the fall of 1991, production requirements for 1992 releases were reduced by 100,000 fish. In response, 190,943 (4,235 lb) 4-inch Brood Year 90 westslope cutthroat were stocked in October.

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Fry releases included 103,660 (557 lb) of Brood Year 90 westslope cutthroat excess to production needs. The production of Brood Year 91 fish included 10,000 (77 lb) Henrys Lake brook trout, 50,040 (25 lb) westslope cutthroat, and 10,151 (81 lb) domestic Kamloops for release in lowland and mountain lakes.

Annual costs to rear and distribute fish from Clark Fork Hatchery are listed in Table 3.

HATCHERY IMPROVEMENTS

During 1991, construction of six 4 ft x 4 ft x 40 ft concrete intermediate rearing raceways was completed. These replace six older raceways which were too shallow for optimum rearing of westslope cutthroat.

Hatchery personnel remodeled one end of the old crew's quarters, that now serves as our office, to produce a laboratory area. New cabinets with sink and counters were constructed and water and electrical service installed.

Summer JTPA laborers painted the exterior of the shop, hatchery building, office, and two residences and garages.

Major construction needs include:

1. A pump and piping to supply pathogen-free water for rearing brood stock, eggs, and fry. One well, with a tested flow of 1,000 gpm, was drilled and capped in 1989.

2. Construction of concrete broodstock ponds to replace the earthen ponds now in use.

3. Construction of additional covered shop/garage space to facilitate vehicle/equipment repair or construction during inclement weather.

FISH HEALTH

Maintaining a disease-free population at the Clark Fork Hatchery continues to be hampered by the water system. The majority of rearing water comes from Spring Creek, which harbors a population of brook trout shown, in past samples, to carry Infectious Pancreatic Necrosis (IPN). Additionally, losses to Bacterial Kidney Disease (BKD), although never catastrophic, have been chronic in the westslope cutthroat broodstock and production lots (Table 4). Brook trout at Clark Fork suffer a spring drop-out in April each year. Although the outward symptoms resemble those of IPN, laboratory analysis has never isolated viral pathogens.

During August 1991, mortalities in Brood Year 1990 westslope cutthroat rose to nearly 1.0%. All fish continued to feed actively and did not appear

stressed, but losses continued at 50 to 100 fish per day in ponds containing 160,000 to 180,000, loaded at a Density Index of <0.25. When necropsies were performed, the fish appeared normal, with gills and internal organs in good condition. Moribund fish were bloated with large volumes of fluid, along with feed, which greatly distended the stomach. Losses continued until September 5, 1991. To support a hatchery construction project, the water supply lines to the large raceways were shut off, and minimal sustaining water was supplied by pump for several hours while a valve was installed in the main line. The fish were extremely stressed, and a poor feeding response and sharp rise in mortality were expected. All mortalities were removed following the pumping episode so that losses due to this procedure could be documented. During the following four days, contrary to expectations, zero mortalities were observed. On day five, feeding was resumed at half ration. The following morning, 50 to 100 mortalities and moribund fish were observed. A feed problem was suspected, although Biodry 4000 had been fed as a production diet for nearly two years with no health problems and an increased growth rate over previous diets. Feeding was suspended and, again, mortalities ceased. When feeding was resumed several days later, mortalities recurred. The feed supplier was contacted and a shipment of Biodiet, in the same size, was delivered immediately. Three raceways of Brood Year 1990 cutthroat were fed Biodiet, Biodry 4000, and Rangen's soft moist feed at half ration, and then at full ration with losses only occurring in the group fed Biodry 4000. Bioproducts Inc. (Warrenton, Oregon) replaced all Biodry 4000 with Biodiet feed and began chemical analysis and historical review of the manufacturing procedure of the lot of feed causing losses. Samples of the feed were fed to test lots of rainbow trout held at their facility with no significant losses. During October 1991 while the testing was being completed, and cutthroat were fed Biodiet, Spring Creek water temperatures dropped from 50°F to 40°F. When tests were repeated early in November, with the same Biodry 4000 and later lots of Biodry 4000, mortality could not be demonstrated. To this date, no determination has been made as to the cause of mortalities.

RECOMMENDATIONS

An underlying obstacle to preventing disease at the Clark Fork Hatchery is surface water source. Even if eggs received are obtained from disease-free sources, continued introduction of water which harbors pathogen-infected populations of fish predisposes Clark Fork fish to infection. With the present water system, there is no hope of ever obtaining a disease-free certification. Further development of the production well drilled in 1989, and construction of covered concrete brood stock ponds, would be initial moves towards improving current operations. With pathogen-free water for rearing, disease-free westslope cutthroat eggs could be obtained from either wild or domestic sources and used to develop **a** viable broodstock.

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FISH STOCKED AND TRANSFERRED

The Clark Fork Hatchery program distributes fish in Region 1 as directed by Idaho Department of Fish and Game fishery management. The program includes; redistributing rainbow trout for put-and-take fisheries; distributing brown, brook, and cutthroat trout fingerlings for put-grow-and-take fisheries; distributing brook, cutthroat, golden, and Kamloops trout fry and grayling to remote sites; and redistributing warmwater and coolwater game fish into Region 1 waters.

Clark Fork Hatchery personnel redistributed approximately 117,000 size 3 (>9 inches) rainbow trout to waters of Region 1, north of Couer d'Alene, from March to October 1991. These trout were received from the American Falls and Nampa hatcheries.

Fry releases of cutthroat, domestic Kamloops, and grayling were delivered to 22 mountain lakes by backpack, horseback, and helicopter.

During October 1991, 62,085 5-inch Brood Year 90 westslope cutthroat were transferred to net pens in Lake Pend Oreille for rearing to release in May 1992.

FISH SPAWNING

The Clark Fork Hatchery maintains a captive westslope cutthroat broodstock population to provide for needs within Region 1. Inability to maintain a disease-free population prevents transfer of eggs or fish to other regions. Presently, nearly 25,000 2- to 4-year-old brood fish are held to spawn in their fourth and fifth year. This provides a potential for taking 3 million green eggs, yielding from 1 to 2 million eyed eggs. During past years, the egg requirement has varied substantially. Fish requirements have ranged from over 1 million "button up" fry for nursery stream release, to 150,000 to 350,000 2-year-old 6-inch fish for release in large lakes. To maintain a broad range of flexibility for fishery management staff, the broodstock population has been held to meet the high-end requirement. Excess fry are released, to comply with Regional preference, when annual population analysis and stocking requirements have been completed.

During the 1991 spawning season, May 1 to June 12, 1991, 2,188,528 eggs were collected (Table 2). Average fecundity in 4,271 females was 512 eggs/female. Although a saline diluent was utilized during fertilization and the iodophor disinfection solutions were buffered, eye-up was very poor in 1991, as in the past two years. Only 703,861 eyed eggs resulted, for an eye-up of 32.2%; well below the expected 50% to 60%. The cause of poor eye up has not been determined.

In 1991, rather than retaining Brood Year 89 Clark Fork strain westslope cutthroat for future broodstock, they were replaced with approximately 8,000 genetically pure westslope cutthroat received from Montana. These trout were

reared at both the Cabinet Gorge and Sandpoint hatcheries prior to transfer to the Clark Fork Hatchery. On December 31, 1991, they averaged 9.5 inches, which is 10% larger than the last two year classes of Clark Fork broodstock at the same age. The warmer water temperature during early rearing at the Cabinet Gorge Hatchery was probably responsible for this increased size. The affect of this accelerated growth on size or age at maturity and egg production remains to be evaluated.

FISH FEED

Normal production feeding utilizes Bioproducts Inc. Biodiet starter and Biodry 4000 diet with ration quantity adjusted to growth on a daily basis. The feed projection program uses Haskell's formula with Delta L adjusted for expected monthly water temperature. Data on Spring Creek daily water temperature has been collected since 1980. Feed tests utilizing a variety of diets, feed delivery techniques, and rearing densities over the past two years have been utilized to institute the current program. Feed utilized and total cost during 1991 is found in Table 5.

PUBLIC RELATIONS

Public relations efforts in 1991 were similar to those of previous years. There were approximately 3,000 visitors to the station again this year. Hatchery personnel made efforts to talk with as many of them as possible. As always, numerous tours were scheduled and provided to public and private schools, 4-H and FFA groups, agencies which work with tours for handicapped people, and senior citizens as well as families.

Much less time was spent with the Lake Pend Oreille Idaho Club in 1991, since the net pen project was turned over to Sandpoint Hatchery, but dealings with members of this group in other matters shows that the positive working relationships established during the establishment of the net pen rearing project continue. The Boundary Backpackers were helpful again in 1991. Members of this club planted cutthroat fry in six mountain lakes for us.

The hatchery manager participated in KSPT radio's "Speak Up North Idaho" program from August to December. This is a monthly one-hour call-in talk show. This has been an excellent opportunity to express IDFG reasoning behind recent actions, as well as an opportunity to inform the public of the volunteer programs that have been so beneficial to hatchery operations.

The fish culturist presented the Region 1 Fisheries Overview slide program to three classes at Sandpoint High School.

Clark Fork Hatchery has been stocking a newly-created pond near the east shore of Priest Lake. Bull Moose Lake was built cooperatively between IDFG and The Huckleberry Bay Company to provide an accessible low-tech fishery without

special harvest regulations in the Priest Lake area. The lake was stocked and opened to the public in July 1991. Since that time, Bull Moose Lake has proven to be very popular with local residents and campers alike.

SPECIAL PROJECTS

Control of Bacterial Kidney Disease Throuqh Diet Manipulation

A study was conducted to test the effectiveness of four different feeds in preventing or controlling outbreaks of Bacterial Kidney Disease Renibacterium salmoninarum. BKD has been epizootic in the westslope cutthroat at the Clark Fork Hatchery in the past causing substantial losses. The presence of BKD can be found in both production lots and broodstock. During 1989, representatives of Bioproducts Inc. had indicated some success in preventing outbreaks of BKD simply by feeding their diet with no supplemental antibiotic treatment. The four feeds compared in this study were:

1. Bioproducts Inc. Biomoist - this is the Oregon Moist Pellet (OMP) formula, utilized for standard production at the Clark Fork Hatchery prior to 1988.

2. Bioproducts Inc. Biodry 4000 - a semi-dry feed claimed to be beneficial in preventing BKD outbreaks.

3. Rangen Inc. (Buhl, Idaho) Rangen's Salmon Soft Moist - a semi-dry feed which had been used in preceding years with good success. This had been the Idaho Department of Fish and Game designated semi-dry feed prior to fall 1989 and was used in this study as a control diet.

4. Rangen Inc. Rangen's Salmon Soft Moist (top-dressed with Erythromycin) - the same ration as "group 3" above, except top-dressed with erythromycin at a rate equal to 4.5 g erythromycin per 100 lbs of fish per day, for a 21-day period.

METHODS

All Brood Year 89 westslope cutthroat had been fed Rangen's Salmon Soft Moist (SM) feed until December 12, 1989. Fish were reared on Rangen's SM until December 12, 1989, at which time all lots were combined to remove differential size or age distribution and then split out to separate rearing units. Two fiberglass troughs and two concrete vats were used for each study group. Standard production rearing conditions were replicated throughout the study. The troughs were initially loaded with 24 lbs, or 8,354 fish at 348/lb (DI=.68). The vats were initially loaded with 72 lbs, or 25,063 fish (DI=.60). Feeding rates

were adjusted daily based on water temperature and growth. On March 19, 1990, each study group was sampled to determine the prevalence of BKD. Five fish from each trough and each vat (20 fish from each group) were screened using the florescent antibody test (FAT) method (Table 6).

Beginning on May 11, 1990, the Rangen's SM feed for group 4 was top-dressed with Galimycin (23.12% active erythromycin phosphate) at a rate intended to deliver 4.5 g of erythromycin for every 100 lbs of fish per day. Vegetable oil was sprayed onto the feed as an adhesive, and the feed and Galimycin mixed thoroughly. The treatment lasted 21 days. On July 19, 1990, all groups were sampled again using the FAT method (Table 6).

At the end of July, the Biomoist group (group 1) was dropped from the study. It was apparent that these fish were showing a decreased growth rate as water temperatures rose (Figure 1) preliminary results showed that this feed provided no obvious benefit in controlling BKD (Table 6), and the number of available rearing ponds for separate rearing was exceeded as well. A decision was made to combine these fish into the non-study production fish to recoup their growth potential. All other groups were transferred out to the large raceways, with each test group placed in a separate raceway. These three groups were reared on their respective diets until liberation in May 1991. The groups were tested using both the FAT and enzyme-linked immunosorbent assay (ELISA) methods (Table 6).

DISCUSSION

For the final sample, IDFG pathologists used both the FAT technique and a relatively new process known as ELISA. All FAT samples were negative for BKD, but ELISA (which uses 5 fish pools) detected BKD in both Rangen groups and was negative for the Biodry 4000 group. ELISA has been significantly more sensitive to BKD infection than FAT.

Group 2, had a 15% prevalence of BKD early in the study at the time of the first sample. BKD was not detected in Group 2 throughout the rest of the study using either method. This may indicate that Biodry feed has a positive effect on removal of BKD from a population. Hatchery personnel did observe occasional mortalities in this group with symptoms indicative of BKD throughout the rearing cycle. Biodry 4000 may be beneficial in reducing the prevalence of BKD, but probably does not completely eliminate the disease from the population. Group 1 fish were the most responsive to feed and appeared the healthiest throughout the study. A better growth rate (Figure 1) and lower cost supported use of Biodry 4000 over Rangen's SM as a production feed. Additionally, the Biodry feed was much easier to handle and vendor response kept feed available throughout the entire study.

The remaining two groups were both fed Rangen's SM feed. The final FAT results would indicate that these fish also were free of BKD, but ELISA results indicate otherwise. With the greater sensitivity of ELISA, we were able to detect low-level carriers in both of these groups. Group 4, fed erythromycin-

dressed feed, displayed a substantial decrease in BKD after one treatment. Group 4 had a high prevalence of BKD in the initial sample, with 35% of the sample testing positive. That incidence was reduced to 1.6% one month after the treatment. The untreated group 3 declined from a 5% to a 1.6% incidence in the FAT over the same period. ELISA groups the samples into 5 fish pools for analysis. As a result, we cannot use a direct comparison with FAT and these earlier samples, but we can use a relative comparison between separate ELISA samples. The overall results indicate that these cutthroat seem, over time, to regress to a "carrier" state that is not well detected by FAT. Larger sample sizes, and more frequent sampling in future test groups, may reveal more on this question. Also, the top-dressing method used provides an uncertain dosage of erythromycin to the fish. This drug is very soluble in water, and much of it may have washed off in the feeding process. Top dressing feed is also a very time-consuming task. Biodry feeds are available with erythromycin pre-mixed into the pellets. This would seem to be an ideal treatment method for future tests.

FEED STUDY

A comparison of two closed formula semi-dry feeds was conducted during 1991. The data was collected concurrent with a study to evaluate the merits of diet and medication in preventing BKD. Using the hatchery's feed projection program to assure consistency between groups, growth, survival, and conversion were evaluated. Figure 1 depicts monthly length gain of each study group over the 19-month study. The feeds appeared to perform equally during the first six months, but group 2 (Biodry 4000) fish began to pull away in the summer of 1990. In July of 1990, we experienced difficulties in getting feed delivered from Rangen's. All fish were taken off feed, when the Rangen's feed ran out, to keep continuity among the groups. After 12 days off feed, and still no feed from Rangen's, the decision was made to put the Biodry fish back on feed. It was another 12 days before Rangen's feed arrived. The failure of a vendor to meet contracted delivery specifications should be included in growth expectations for that feed. This 12-day advantage is evident in Figure 1 for the month of August 1990. As Figure 1 shows, the Biodry group (group 2) had already moved above the others. Growth gained in the months following August 1990 indicates that Biodry continued to perform superior to Rangen's. The gap between the test groups continued to widen until April 1991, when the Biodry fish were fed a ration reduced by 50% in preparation for outplanting. They were eventually taken completely off feed, and all of that group were planted. The Rangen's fish continued to be fed as before, and were planted in June 1991 when they finally reached release size. Biodry 4000 provides superior growth during the warm water months at a lower cost per pound of feed (Table 7).

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ACKNOWLEDGEMENTS

We would like to thank the U.S. Forest Service for providing air time with their helicopter to stock mountain lakes. We would also like to thank the Boundary Backpackers Club for packing fish to *mountain* lakes. Both of these groups were of great assistance in completing the mountain lakes stocking program.

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Table 1. Fish production at the Clark Fork Hatchery, January 1, 1991 to December 31, 1991.

Species & strain	Source	Beginning number	Beginning pounds	Ending number	Ending pounds	No/lb stocked	Destination
Brook Trout BY 91	Henrys Lake	22,800	eggs	6,075	93	10,000/ 77	Mirror Lake
Cutthroat C2 BY 86	Clark Fork	4,488	2,059	0	0	980/ 410	Jewel Lake
Cutthroat C2 BY 87	Clark Fork	8,959	5,119	8,363	8,711		broodstock
Cutthroat C2 BY 88	Clark Fork	8,610	1,998	8,090	4,494		broodstock
Cutthroat C2 BY 89	Clark Fork	316,306	17,357	0	0	268,411/ 21,315	Region 1
Cutthroat C2 BY 89	Montana	4,979	535	6,870	2,082		broodstock
Cutthroat C2 BY 90	Clark Fork	566,768	1,481	160,031	6,382	356,688/ 6,834	Region 1
Cutthroat C2 BY 91	Clark Fork	703,861	eggs	433,907	1,171	500,400/ 25	Region 1
Kamloops K1 BY 91	Gloyd Springs	30,000	eggs	7,589	232	10,151/ 81	Region 1

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Table 2. Spawning summary, Clark Fork westslope cutthroat C2, January 1, 1991 to December 31, 1991.

Date	Age of adult	Females spawned	Eggs collected	Average fecundity	Percent eye-up	Eyed eggs
5/1/91	5	167	74,665	447	52.6	39,290
5/3/91	4	313	184,615	462	44.4	82,051
5/6/91	5	127	59,976	472	48.9	29,370
5/8/91	4	220	123,350	560	49.0	60,469
5/10/91	4	307	158,400	516	48.3	76,044
5/13/91	5	308	111,622	362	51.2	57,153
5/15/91	4	715	366,496	513	37.1	135,880
5/20/91	5	197	89,838	456	18.8	16,926
5/22/91	4	666	348,996	524	15.9	55,576
5/28/91	5	316	122,202	387	21.6	26,432
5/29/91	4	551	297,332	540	20.0*	59,466
6/3/91	5	113	68,380	598	20.0*	13,676
6/5/91	4	168	116,550	694	20.0*	23,310
6/10/91	5	48	27,442	571	32.0	8,778
6/12/91	4	55	38,664	702	50.3	19,440
Total		4,271	2,188,528	512	32.2	703,861

*Estimate, eggs not picked.

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Table 3. Cost of fish produced at the Clark Fork Hatchery, January 1, 1991 to December 31, 1991.

Species	Actual* production	Weight** pounds	Costs to produce and stock	Cost per 1,000	Cost per inch
(BK) Henrys Lake Brook trout 3"	16,075	170	$3,000	$186.63	$0.062
(C2) cutthroat BY 89 >6"	268,411	21,315	$25,000	$93.14	$0.015
(C2) cutthroat BY 90 2-5"	356,688	11,735	$20,000	$56.07	$0.011
(C2) cutthroat BY 91 1"	50,040	1,196	$10,000	$199.84	$0.20
(K1) Kamloops BY 91 1-2"	10,151	313	$2,000	$200.00	$0.20

*Number of fish stocked does not include fish heldover.
**Weight includes both stocked weight and increase in weight for 1991.

Table 4. Fish health report for Clark Fork Hatchery, January 1, 1991 to December 31, 1991.

Date	Log No.	Species/lot	Diagnosis	Remarks
5/2/91	91-121	C2 BY 90	Negative for virus and BKD	
5/2/91	91-122	C2 BY 89	Negative for virus 2A pos BKD 1/4 2B pos BKD 2/4 3 pos BKD 1/4 4 neg BKD 0/4	Raceway 2A Rangen feed with erythromycin Raceway 2B Rangen feed no medication Raceway 3 Biodry Raceway 4 Biodry
5/2/91	91-123	C2 Brood stock (all)	Negative for BKD, virus, whirling disease Positive for coldwater disease	

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Table 5. Fish feed used in 1991 at the Clark Fork Hatchery.

Size	Source	Pounds	Cost/pound	Total cost
Biodiet starter #1	Bioproducts	637.7	$00.818	$521.64
Biodiet starter #2	Bioproducts	416.4	$00.818	$346.62
Biodiet starter #3	Bioproducts	984.8	$00.818	$805.57
Biodry 4000 1.0 mm	Bioproducts	4,164.8	$00.477	$1,986.61
Biodry 4000 1.3 mm	Bioproducts	264.0	$00.477	$125.93
Biodry 4000 1.5 mm	Bioproducts	1,741.2	$00.477	$830.55
Biodry 4000 2.5 mm	Bioproducts	10,500.0	$00.459	$4,819.50
Biodry 4000 3.0 mm	Bioproducts	2,562.8	$00.459	$1,176.33
Biodry 4000 5.0 mm	Bioproducts	3,971.6	$00.459	$1,822.96
Biodry 4000 6.0 mm	Bioproducts	5,109.3	$00.459	$2,345.17
	Bioproducts	1,462.0	$00.459	$671.06
Semi moist 6.5 mm	Moore Clark	4,074.4	$00.370	$1,507.53
Soft moist 3/32"	Rangens	5,935.2	$00.560	$3,323.71
Soft moist 1/8"	Rangens	989.0	$00.560	$553.84
Totals		42,813.2	$00.487	$20,837.02

Table 6. Results of BKD tests on experimental groups, by date, (FAT and ELISA methods). Clark Fork Hatchery, March 19, 1990 to April 30, 1991.

Feed type	Group #	3-19-90 FAT	7-19-90 FAT	4-30-91 FAT	4-30-91 ELISA*
Biomoist	Gr #1	0/10	2/60	----	----
Biodry 4000	Gr #2	3/20	0/120	0/20	0/4*
Rangen's S.M.	Gr #3	1/20	2/120	0/20	2/4*
Rangen's S.M. (Erythromycin)	Gr #4	7/20	2/125	0/20	1/4*

* - 5 fish pools used for analysis.

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Table 7. Growth, feed conversion, and cost in westslope cutthroat at the Clark Fork Hatchery, December 1989 to May 1991.

	Biodry 4000	Biomoist*	Rangen soft moist	Rangen soft moist**
Number of fish				
start	66,834	16,708	66,834	66,834
finish	52,948	16,295	51,150	47,696
Survival(%)	79.2	97.5	76.5	71.4
Total length (in)				
start	2.01	2.01	2.01	2.01
finish	6.56	3.70	6.08	5.92
Length increase (in)	4.55	1.69	4.07	5.92
Pounds of fish				
start	192	48	192	192
finish	5,242.4	288.9	4,027.6	3,456.2
Pounds gained	5,050.4	240.9	3,835.6	3,264.2
Pounds of feed fed	6,191.5	277.0	4,704.5	4,490.5
Feed conversion	1.226	1.150	1.227	1.376
Feed cost per pound	$0.461	$0.520	$0.577	$0.577
Total feed cost	$2,853.65	$144.04	$2,715.44	$2,593.25
Cost per pound gained	$0.565	$0.598	$0.708	$0.794

* Fish fed Biomoist were combined with general production after 6 months.
** Rangen feed top dressed with erythromycin for a 21-day period in May 1990.

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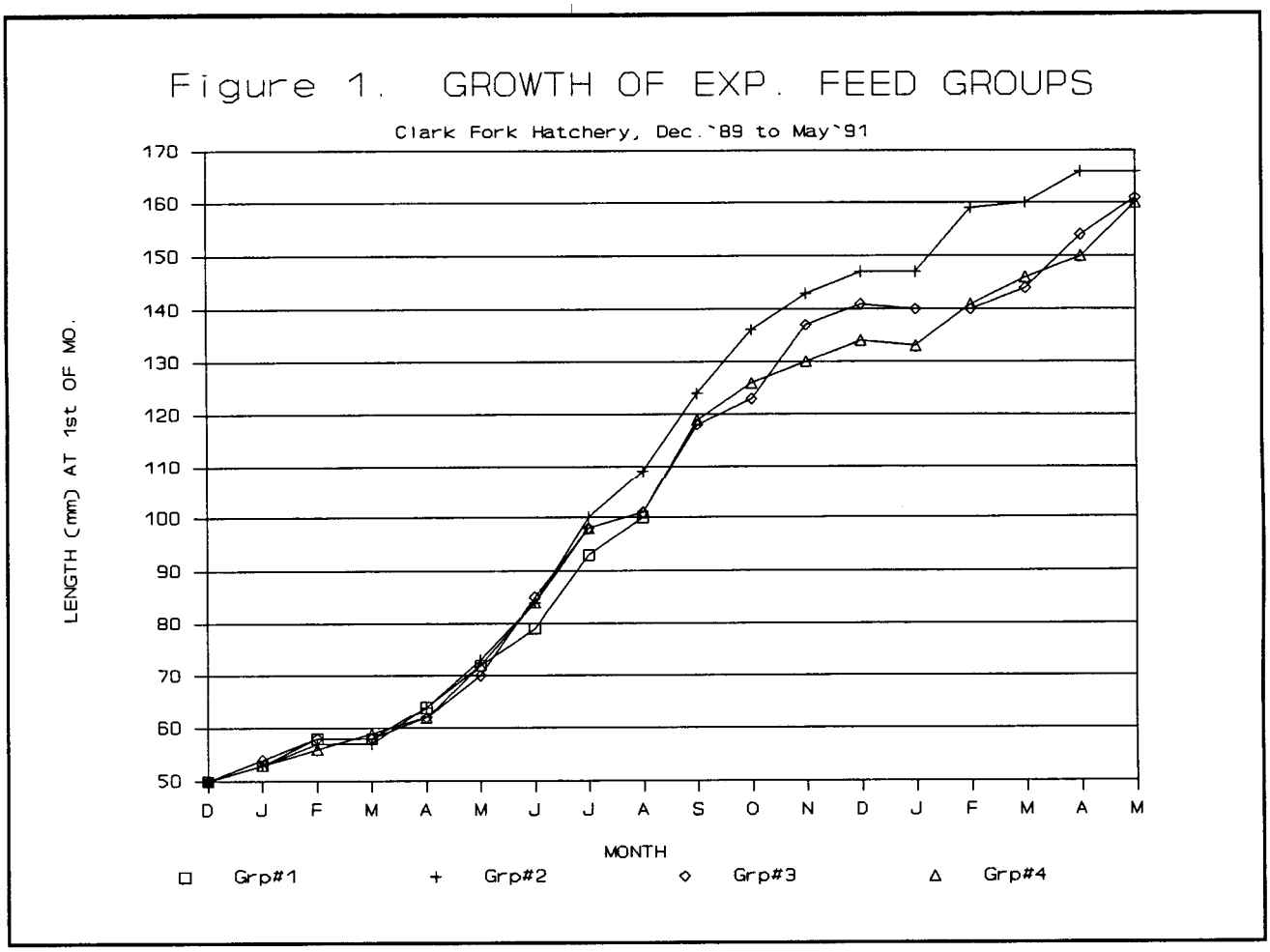
Figure 1. GROWTH OF EXP. FEED GROUPS
Clark Fork Hatchery, Dec.`89 to May`91
LENGTH (mm) AT 1st OF MO.
170
160
150
140
130
120
110
100
90
80
70
60
50
D J F M A M J J A S O N D J F M A M
MONTH
Grp#1
Grp#2
Grp#3
Grp#4

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